refinery, petrochemical or other chemical synthesis streams or other naphtha streams, especially in catalytic cracking reactors, e.g., conventional FCC units which ordinarily employ heavier feeds such as deep cut gas oil, vacuum gas oil, thermal oil, residual oil, cycle stock, whole top crude, and the like. A key element of the present invention is its use of a catalyst comprising a zeolite which zeolite itself has been modified by treatment with a phosphorus compound, combined with a substantially inert matrix material. The catalyst comprises a zeolite component which is necessarily treated with a phosphorus compound.

Applicants also acknowledge the Examiner's objection to line 1 of page 2 of the Specification for missing the phrase ",a small" which was originally present. Accordingly, to remedy this shortcoming, the Specification has been amended to include the missing phrase.

Applicants will shortly provide a revised declaration in compliance with 37 CFR 1.67(a) to identify the citizenship of each inventor, viz., Ke Liu.

Rejection Under 35 U.S.C. § 103(a)

Claims 1-10 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,069,287 to Ladwig et al. (Ladwig) in view of U.S. Patent No. 5,997,728 to Adewuyi et al. (Adewuyi).

The Examiner cites Ladwig as disclosing a process for selectively producing C_2-C_4 light olefins and aromatics by processing a 65° to 430°F boiling range naphtha feed which the Examiner construes as overlapping the presently claimed feed boiling range. The feed is contacted with a catalyst comprising 10 to 50 wt.% medium pore zeolite such as ZSM-5 and ZSM-11 of silica/alumina molar ratio less than 70. Process conditions include temperatures from about 500° to 650°C, hydrocarbon partial pressure of 10 to 40 psia and catalyst to naphtha weight ratio of 3 to 12. The catalyst preferably has an "inactive inorganic matrix" (compared to the present claims' "substantially inert matrix") which *matrix* may be modified with phosphorus. Ladwig is also cited as introducing steam (up to 50% wt. of naphtha) concurrently with the naphtha feed. The Examiner argues that a teaching "that aromatics in the heavy naphtha product may be recycled

suggests that aromatics are produced in the process since the aromatics are part of a product."

The Examiner admits that Ladwig fails to disclose treating the zeolite component of the catalyst with phosphorus-containing compound to provide a catalyst with the claimed amount of phosphorus, does not disclose the claimed WHSV, does not disclose the claimed amount of alumina in the matrix, and does not disclose the product compositions. Accordingly, the Examiner relies on U.S. Patent No. 5,997,728 to Adewuyi et al. as disclosing the adding of phosphorus to ZSM-5 to stabilize and resist attrition to the catalyst, while improving activity retention.

The Examiner concludes one skilled in the art would have found it obvious to modify Ladwig's process by adding phosphorus to the zeolite as suggested by Adewuyi, in order to provide a longer useful life of the zeolite. The Examiner further argues it would be obvious to modify Ladwig by utilizing the presently claimed amounts of phosphorus "because one would utilize a known effective catalytic component in amounts that would result in the most effective process" and the claimed WHSV. The Examiner also urges it would be obvious to modify Ladwig's process by using alumina in the presently claimed amounts because Ladwig's catalyst matrix may contain alumina and must also not be catalytically active. Finally, the Examiner contends it would be obvious to modify Ladwig by adjusting conditions to produce products having the presently claimed compositions because Ladwig teaches that changing process conditions affects product yield and purity.

This rejection is respectfully traversed.

Applicants maintain their arguments respecting Ladwig which were made in their response of September 6, 2000. In regard to Adewuyi, applicants direct the Examiner's attention to several important differences. First, Adewuyi discloses an FCC process carried out at relatively low temperatures of 925°-1050°F using heavy hydrocarbon feeds boiling above 650°F. In contrast, the present application utilizes a feed containing a significantly lower boiling fraction, viz., a C_4+ naphtha hydrocarbon feed, boiling above 31°F. Second, the catalyst

of Adewuyi is significantly different from that of the present invention inasmuch as the former contains large pore zeolite. In contrast, applicants' Specification at page 8, lines 28-29 teaches that "the present invention uses only ZSM-5 and/or ZSM-11 without large pore zeolite." Adewuyi's catalyst contains shape-selective zeolite only as a minor component (10 to 35 wt.% additive per claim 1, lines 13 and 14). Indeed, Adewuyi "calls for an unusually active large pore cracking catalyst" (column 10, lines 57-58) in addition to the zeolite, while the present claims require only the zeolite and a "substantially inert matrix material." Thus, one skilled in the art familiar with Ladwig seeking to process light naphtha feed over a catalyst comprising a shape-selective zeolite catalyst having an "inorganic oxide matrix which is not catalytically active," would not likely consider Adewuyi for methods of introducing phosphorus to the process inasmuch as the feed and catalysts are so different.

The Examiner cites Adewuyi at page 6, lines 1 and 2 of the October 10, 2000 Office Action as disclosing that "adding phosphorus to ZSM-5 stabilizes it and makes it more attrition resistant." However, Adewuyi's Examples all use additives that "contained about 15.0 wt.% ZSM-5 in a *phosphorous stabilized matrix*" (column 12, lines 64-65) rather than the phosphorus-treated zeolite required by the present claims. Moreover, Adewuyi actually teaches *away* from the present invention inasmuch as it teaches the "primary effect of phosphorous stabilization is to make the ZSM-5 last longer in FCC use, rather than produce significantly different yields" (column 12, lines 65-67). Accordingly, one skilled in the art familiar with Ladwig and Adewuyi seeking to improve lower olefin selectivity would not likely consider *any* phosphorus treatment of the catalyst for the purpose of increased light olefin yields, much less the present invention's phosphorus treatment of the zeolite component. As applicants' Examples show at page 19, line 5, Catalysts A and B whose zeolite components are treated with phosphorus compound, exhibit significantly greater yields of ethylene than the non-phosphorus-treated catalyst (11.8% and 7.9% versus 5.3%). One skilled in the art relying on Adewuyi's teachings concerning phosphorus-containing catalysts would certainly find such results unexpected. More importantly, one

relying on Adewuyi's teachings would lack any incentive to modify the catalyst with phosphorus compounds in order to significantly improve lower olefin selectivity.

Given the above-noted shortcomings of the combination of references relied upon by the Examiner, particularly their failure, singly or jointly, to suggest using a phosphorus-treated *zeolite* to improve light olefin selectivity in light naphtha processing, as shown by applicants, it is respectfully urged that the references fail to disclose or suggest the presently claimed subject matter.

Accordingly, it is respectfully submitted that the present claims meet the requirements of 35 USC 103(a) and withdrawal of the rejection thereunder is therefore requested.

CONCLUSION

Applicants respectfully submit that the foregoing amendment and arguments obviate all of the outstanding rejections in this case and place the application in condition for immediate allowance. Allowance of this application is therefore earnestly solicited.

Respectfully submitted,

By____________________

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CERTIFICATE OF MAILING UNDER 37 CFR 1.8

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on December 8, 2000.

Laurence P. Hobbes